WORKING DRAFT

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Oil Module

Working Paper

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I

Perhaps the most important factor influencing formulation of the oil module is its intended purpose. Clearly, its intent is not (a) to characterize the operation of the world oil industry in any aggregate sense, or (b) to be "valid" for crude oil production in all countries. Neither, however, is it to provide detailed point predictions of the operation of the crude oil industry within any of the nations under study. What we seek is the formulation of a module which represents the characteristics of the oil industry that are considered (by United States policy-planners) to be salient to government officials of the nations under study, subject to the further requirement that the module, when provided with realistic initial conditions and control inputs, behave plausibly in the view of knowledgeable observers. This last point should be commented upon further.

In the decision module, producing-nation decision-makers will observe and measure the performance of various sectors (processes) through the use of monitor variables.[1] Monitor variables are just what their name would lead one to expect: a small set of information variables which tap the key characteristics of a process and which are of interest for decision-making concerning that or another process. They may come directly from a process, or they may result from analysis of and abstraction from the data produced by the process. In our oil module, then, we want to explicitly include any variables

directly involved in the process which are also likely to be used unaltered as monitor variables. We also wish to include any variables directly involved in the process which are likely to be analyzed or abstracted from in order to obtain values for monitor variables. In this latter case, however, we may not be aware of the need to include some process variable until we encounter that need during development of the decision module, and so we wish to emphasize especially that no claim is made that all necessary process variables have been included in our initial version of the oil module.

Similarly, we ideally would like to have no more detail in the process module than is necessary to provide reasonably accurate values for the monitor variables. If one recalls that the purpose of the module is only to permit analysis of decision-maker choices, then detail beyond that necessary to generate the monitor variables becomes relatively superfluous.

We would also like to obtain some sort of consensus of knowledgeable observers, concerning the monitor variables (and, if necessary, how they are generated), before the structure of the oil module is finally determined. This can be accomplished through an iterative process. Our initial version of the oil module will be considered by knowledgeable policy-planners and they will respond with criticism and suggestions. On the basis of such feedback, revisions to the module will be made, then additional feedback will be sought, and so on until some minimally acceptable degree of consensus is reached concerning the suitability of the module. It is not anticipated that

this process will take long for the module considered by itself. During development of the decision module, however, it may become necessary to add complexity to the module if unanticipated monitor variables are introduced.

The intended purpose of the module has had another effect upon the module's development. Although there is a large literature on oil and oil economics, relatively little of that literature seems to deal in detail with oil operations from the viewpoint of the producing-nation decision-maker. This is probably quite reasonable given the relative lack, until recently, of detailed intervention into the oil industry by the producing-country governments. Nonetheless, it precludes the possibility of using or modifying a previously developed model. This is a somewhat more severe drawback with respect to the oil module than it would be in other sectors, since oil companies are notably non-communicative with respect to information on decision-making aspects of their operations, and the producing-country governments also are understandably reluctant to explicitly reveal their decision criteria and/or monitor variables.[2]

The initial formulation of the oil module contains, as a result, a number of important assumptions. These assumptions will be identified in the next section when the module is described. We hope that most of the assumptions represent reasonable inferences from some of the oil and oil economics literature, given our particular goals for the module.

In addition, the relationships of the producing-country

governments to the operations of the oil industry within their boundaries have been changing rapidly, especially in the last year. The governments have asserted increasing control over contractual arrangements with the oil companies, and over crude oil prices. Initially it was our intention to include contractual arrangements and the Teheran pricing agreement within the module, and to treat them as relatively stable for at least the next few years. Given the turmoil in country-company relationships during especially the past nine to twelve months,[3] however, it seems advisable to consider all contractual arrangements and posted price schedules as scenarios which should be explicitly specified by the user.[4] That is, the emphasis has shifted so that rather than try to consider country-company relationships relatively constant or attempt to generate crude oil prices <u>within</u> the oil module, we simply intend to consider both these areas as exogenous to the process module and currently, at least, as unpredictable beyond the accuracy of a sophisticated observer's educated guess. Eventually it should be possible to include within the decision-module the effects on crude oil prices of producing-country governments.

A final aspect of our module's context which has influenced the module itself is the peculiar nature of crude oil operations in the Middle East, in the Persian Gulf, and in North Africa. In these areas oil lies in huge more or less contiguous pools. The pools are under high natural pressure; water and gas generally are injected into the fields to replace the oil

removed and maintain the pressure, but negligible pumping of oil at the wellhead is necessary, and daily production per well is extremely high. In addition, the legal systems of these countries vest title to, and thus control of, mineral resources in the state. Thus the oil industry has been able to develop these large pools in optimal fashion, drilling only the necessary numbers of wells for the desired rate of production, and drilling them in optimal locations. The result of all of these factors is a very low cost of production, and relatively little uncertainty affecting decisions regarding how to raise production capacity. These implications will be discussed in more detail in the next section, but their general impact on the module is that we may deal with the process aspects of each nation's crude oil operations in relatively highly aggregated form because those operations are quite homogeneous compared with the character of operations in other parts of the world.

Footnotes for Section I

[1]See (especially Chapter 4 of) H.H. Bossel and Barry B. Hughes, <u>Simulation of Value-Controlled Decision-Making: Approach and Prototype</u>, mimeo, 1973.

[2]Except, perhaps, for their demonstrated concern for the posted price of crude oil and for producing-country revenues from oil exports.

[3]For instance, an article in <u>Oil and Gas Journal</u>, (December 31,1973, p. 55) suggests that even the most recently announced posted prices may only be valid through April, 1974.

[4]A small number of "standard" scenarios will be available, and a user may select one of these for his run. But these "standard" scenarios should nonetheless be regarded as speculative.

II

In keeping with the discussion in the previous section, it should be remembered that the module about to be presented is an initial working version. It provides the basis for discussion with, and critical feedback from, knowledgeable decision-makers. We fully anticipate that some revision will be necessary, and indeed have made ease of revision a key feature of our computer programming.[1]

On the other hand, the oil module does represent our efforts at gaining at least a working understanding of the fundamentals of crude oil operations in the producing countries, and also our attempts to simplify, as much as possible, our representation of those operations through the use of what we feel are plausible assumptions and inferences from the literature on oil economics. More will be said later concerning these assumptions, their effects, and our grounds for employing them. First, however, the operation of the module itself will be described. When reading the following description, it will be useful to refer to several figures and a table. Figure II-1 is a simple flowchart of the computer program for the oil module, and Figure II-2 gives the actual current program (written in PL/I). Table II-1 lists all variables employed in the module, along with their definitions and units. Finally, Figure II-3b indicates the conceptual organization of the module.

FIGURE II-1

Simple Flowchart of Computer Program

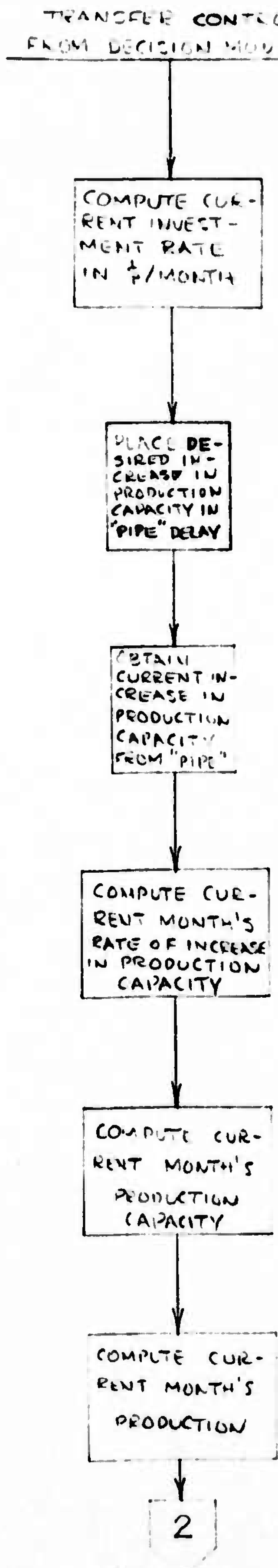


FIGURE II-1 (cont.)

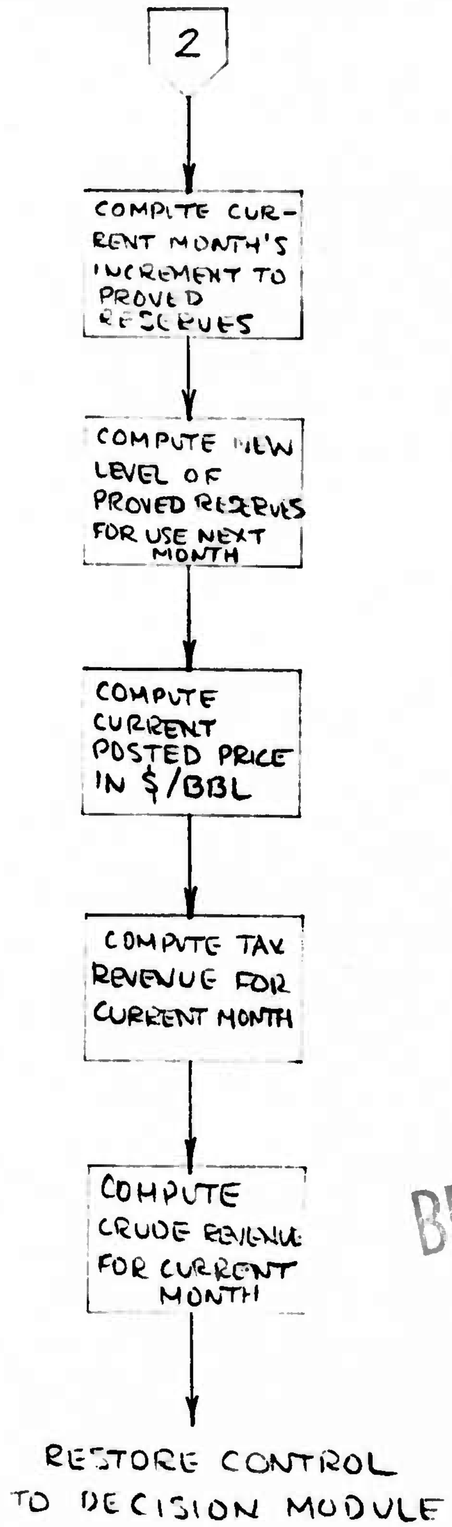


Figure II-2

Listing of Current Program for Oil Module:

```
OIL: PROCEDURE;
   %INCLUDE ADBR;
   %INCLUDE COCI;
   %INCLUDE COP;
   %INCLUDE DAYS;
   %INCLUDE DPIR;
   %INCLUDE DR;
   %INCLUDE EI;
   %INCLUDE IR;
   %INCLUDE MP;
   %INCLUDE P;
   %INCLUDE PAPC;
   %INCLUDE PC;
   %INCLUDE PINCRAT;
   %INCLUDE PR;
   %INCLUDE PRR;
   %INCLUDE CF;
   %INCLUDE CR;
   %INCLUDE CRUDE%;
   %INCLUDE IND%;
   %INCLUDE INDCRUD;
   %INCLUDE INDSALE;
   %INCLUDE PP;
   %INCLUDE ROYALTY;
   %INCLUDE SELBAC;
   %INCLUDE SELBACP;
   %INCLUDE SHARE;
   %INCLUDE TAXPAID;
   %INCLUDE TAXRATE;
   %INCLUDE THISCUR;
   %INCLUDE TPOST;
   %INCLUDE TR;
```

```
%INCLUDE YEAR;

/* compute current investment rate in $/month */
        IR=DPIR*COCI;
/* place desired increase in production capacity
   into "pipe" delay */
        CALL INPIPE('EI', DPIR, ADBR);
/* obtain current increase in production capacity
   from "pipe" delay */
        EI=OUTPIPE('EI', EIPARM);
/* compute current month's rate of increase in production
   capacity */
        PINCRAT=EI/PC;
/* compute current month's production capacity */
        PC=PC+EI;
/* compute current month's production */
        P=PAPC*PC;
        MP=DAYS*P;
/* compute current month's gross increase in proved
   reserves */
        DR=PRR*PR*PINCRAT;
/* compute new level of proved reserves for use
   next month */
        PR=PR+DR-MP;
/* compute current posted price in $/bbl */
        TESTCUR=(THISCUR-LASTCUR)/LASTCUR;
        IF TESTCUR≥.01 THEN CF=TESTCUR;
            ELSE CF=0;
        LASTCUR=THISCUR;
        IF YEAR=74 THEN IF MONTH=1 THEN SWITCH=1;
            ELSE IF YEAR=75 THEN IF MONTH=1 THEN SWITCH=1;
            ELSE SWITCH=0;
        TPOST=TPOST+SWITCH*(.025*TPOST+.05);
        PP=PP+TPOST*CF;
/* compute tax revenue for current month */
        TAXPAID=(PP-COP-ROYALTY*PP)*TAXRATE+ROYALTY*PP;
        TR=TAXPAID*MP*(1-SHARE);
```

```
/* compute independent crude revenue for current month */
        INDCRUD=CRUDE%*MP;
        SELBACP=Ø.5*(TAXPAID+PP);
        SELBAC=SELBACP*(SHARE*MP-INDCRUD);
        INDSALE=INCRUD*(IND%*PP-COP);
        CR=INDSALE+SELBAC;
END OIL;
```

Listing of INPIPE and OUTPIPE procedures, which collectively comprise the "pipe" delay:

```
INPIPE:  PROC(PIPE, VALUE, IDELAY);
         DCL 1 PIPE,
              2 MAX B F(31,Ø),
              2 CELL (*) B FLOAT;
         DCL VALUE B FLOAT;
         DCL IDELAY B F(31,0);
         IF MAX<1|MAX>100|IDELAY<Ø THEN DO;
              PUT 'FATAL INPIPE CALL'
              SIGNAL ERROR; END;
         IF IDELAY>MAX THEN DO;
              PUT 'INPIPE MAX USED'
              IDELAY=MAX;
              END;
         CELL(IDELAY+1)=CELL(IDELAY+1)+VALUE;
         END INPIPE;

OUTPIPE:  PROC(PIPE,IPARM);
          DCL 1 PIPE,
               2 MAX B F(31,Ø),
               2 CELL (*) B FLOAT;
          DCL IPARM B F(31,0);
          IF MAX<1|MAX>100 THEN DO;
               PUT 'FATAL OUTPIPE CALL'
               SIGNAL ERROR; END;
```

```
TEMP=CELL(1);
IF IPARM=1 THEN DO I=2 TO MAX ;
    CELL(I-1)=CELL(I);
    END;
    CELL(MAX)=0.0;
    END;
RETURN (TEMP);
END OUTPIPE;
```

Table II-1

Oil Module Variable List

I. Variables in physical process section of module

ADBR	months	Average Delay Before Return: typical number of months before a given amount of capital invested in production facilities actually increases production.
COCI	$/bbl/da	Cost of Capacity Increase: average overall cost of an increase of 1 bbl/da in production capacity.
COP	$/bbl	Cost of Production: average cost of producing 1 bbl of crude oil and delivering it to a tanker loading facility.
DAYS	days	Days: number of days in the current month.
DPIR	bbl/da	Desired Production Increase Rate: the number of bbl/da production capacity is desired to be increased ADBR months later.
DR	bbl	Discovery Rate: gross increase to proven reserves for a given month.
EI	bbl/da	Effective Investment: the increase in production capacity which is to become operational during the current month.
IR	$	Investment Rate: the amount of capital to be invested in order to achieve an increase in production capacity ADBR months later.
MP	bbl	Monthly Production: actual production for the current month.
P	bbl/da	Production rate: average actual production per day during the current month.

PAPC	dimensionless	Production As Percent of Capacity: the level of production desired by government decision-makers expressed as a fraction of present capacity.
PC	bbl/da	Production Capacity: average daily production capacity for current month.
PINCRAT	dimensionless	Percentage Increase in production capacity: ratio of increase in production capacity to production capacity before increase.
PR	bbl	Proved Reserves: current estimate of oil-in-place which can be recovered with existing facilities and technology and at current prices.
PRR	dimensionless	Proved Reserves Ratio: assumed constant factor which indicates how large an increase in proved reserves will be associated with a given percentage increase in production capacity.

II. Variables associated with contractual arrangements section of module

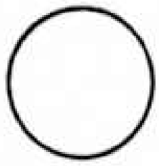
CF	dimensionless	Currency Factor: index of the rate of inflation or deflation of a designated group of currencies.
CR	$	Crude Revenue: revenue accruing to a producing country government through sales of crude oil it owns as a result of participation contracts.
CRUDE%	dimensionless	ratio of that portion of the current month's production which is owned by the producing country government, <u>and</u> which is to be sold independently by the government, to the current month's production.

IND%	dimensionless	ratio of the price at which independent sales of crude oil are made (by a producing country government) to the posted price.
INDCRUD	bbl	the amount of the current month's production which will be sold independently by the producing country government.
INDSALE	$	revenue received by the producing country government from its independent sales of crude oil.
PP	$/bbl	Posted Price: the artificial price used in country-company relationships as a basis for determining (for tax purposes only) company "profits".
ROYALTY	dimensionless	the fixed proportion of posted price which is paid, on each company-owned barrel, as a royalty to the producing country government.
SELBAC	$	revenue received by the producing country government as a result of sales of its share of crude oil production by the oil companies through their regular channels. Such oil is said to be "sold back" by the countries to the companies.
SELBACP	$/bbl	Sellback Price: the price at which sellback transactions are made by the producing country government.
SHARE	dimensionless	the ownership share (proportion) of the producing country government under the terms of a participation agreement.
TAXPAID	$/bbl	Tax Paid price: the cost to oil companies for their share of the oil produced.

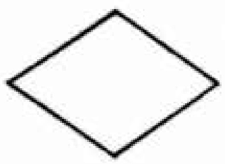
TAXRATE	dimensionless	the proportion of company "profit" on each barrel of crude oil which is owed to the producing country government as a tax.
THISCUR	$	the average value, in $, of a designated group of currencies for the current month.
TPOST	$	posted price which would apply at a given date under the terms of the 1971 Teheran agreement, but excluding the effects of the 1972 and 1973 Geneva agreements.
TR	$	Tax Revenue: the sum of all taxes and royalties paid to the producing country government for the current month's production.
YEAR	yr	the current year at any time during a simulation run.

FIGURE II-3a

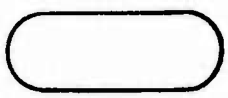
Legend for symbols used in Figure III-3b:



Process information variable

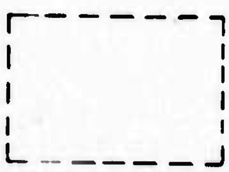


Control information from control stratum



Exogenous information provided by user

Indicates influence of one variable upon another



Specifies additional detail concerning a particular influence mechanism

FIGURE II-3b

Conceptual Flowchart of Module

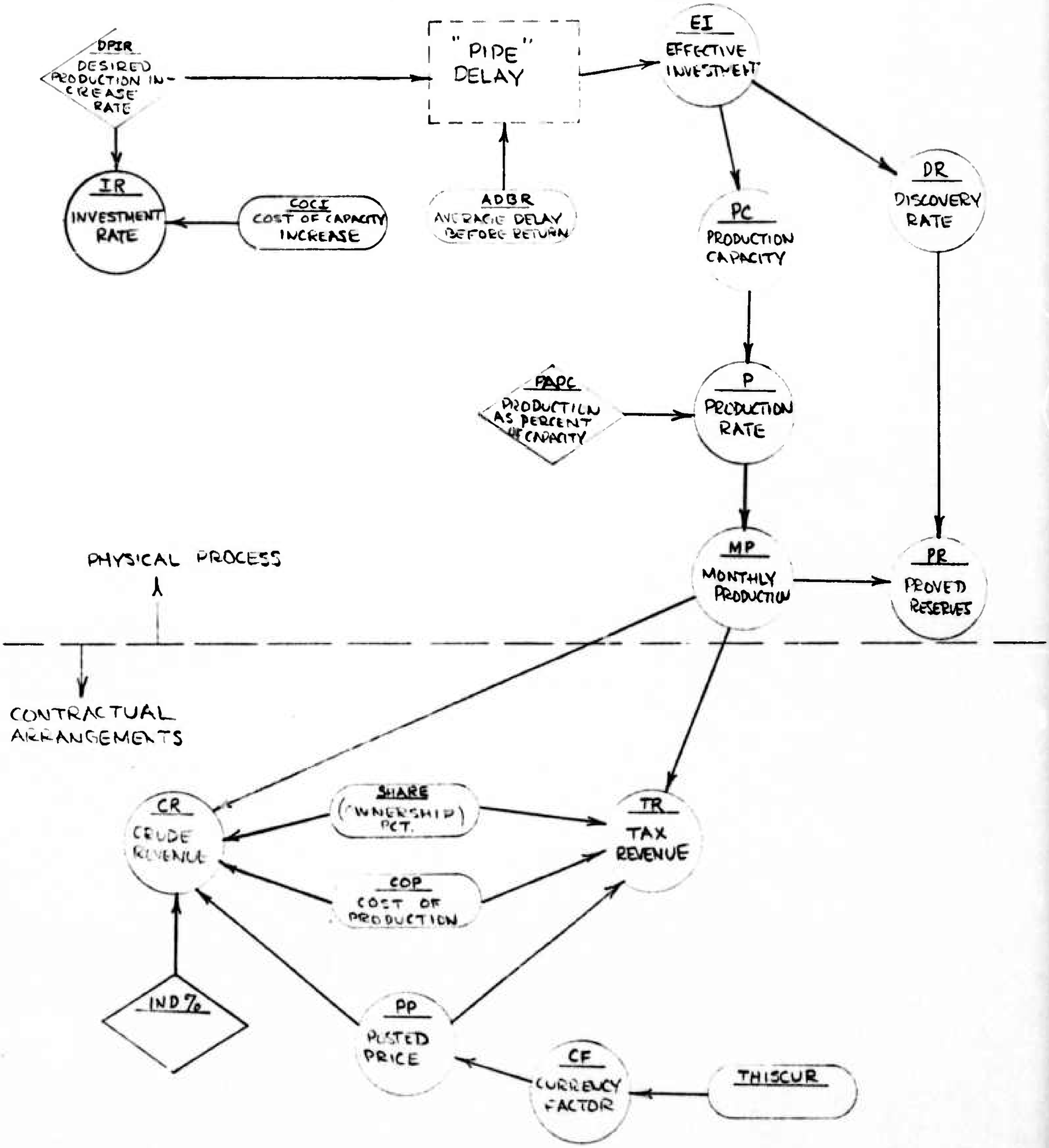


Table II-2

Some Initial Values and Estimates for Saudi Arabia*

SHARE	1973	.25
	74	.25
	75	.25
	76	.25
	77	.25
	78	.30
	79	.35
	1980	.40
	81	.45
	82	.51
	after 1982	.51

ROYALTY	.125
TAXRATE	.55
COP	\$ .10/bbl at present; increasing to \$ .20/bbl in 1985. Assume linear increase. (From Adelman, 1972)
COCI	\$ 313/bbl (Taken from Aramco investment program; Assume \$ 500 million annually for avg. production increase of 1.6 million bbl/da.)
PAPC	1.0 initially, but subject to reduction by decision module.
TPOST	\$ 2.18 initially; adjusted by module thereafter.
PR	92,992 million bbl (Aramco Annual Report 1972) This figure is low for Saudi Arabia as a whole, but all Aramco figures are used here so that data inconsistencies are minimized in this example.
DDR	.1772 computed for increases in PR and P for Aramco in 1972.
P	5,733,000 bbl/da (Aramco Annual Report 1972)

*The values given here are meant to be mainly illustrative. Detailed values and estimates will be given when module is test-run and evaluated.

The module begins each month with a known level of proved reserves (PR), and with a given level of production capacity (PC). If the decision module has determined that an increase in production capacity is necessary and/or desirable, then a desired production capacity increase rate (DPIR) will also be known when the oil module begins operation. When the desired production capacity increase rate (DPIR) is nonzero, some level of capital investment in additional production facilities is called for. In that case, the module relies upon an exogenously supplied cost of capacity increase (COCI) factor, and determines the necessary capital outlay (IR). The desired production capacity increase is then placed into a "pipeline" type delay mechanism.[2]

The module next checks to see if any new production facilities, resulting from earlier decisions to increase production capacity, are due to come on line during the current month. If so, production capacity (PC) is increased by the appropriate amount (EI). Under "normal" circumstances, it is assumed that production will be maintained at essentially 100% of capacity. However, the decision module may have provided that production take place at something less than 100% of capacity. In either case, the production rate (P) for the current month is determined from the product of production capacity (PC) and production as percent of capacity (PAPC). The production rate (P) is expressed

in barrels per day (bbl/d), and the cumulative monthly production (MP) is determined by multiplying P by the number of days in the current month. Cumulative monthly production (MP) is then subtracted from proved reserves (PR). If any increase in production capacity (PC) has taken place, however, an increase (DR) is also made to proved reserves (PR). The magnitude of such an increment to proved reserves is determined by the percentage increase in production capacity (PINCRAT) which came on line during the current month.

At this point, the (very highly aggregated) representation of "physical" crude oil operations is complete. It was suggested in the prior section, however, that the oil process module should take into account whatever variables are required in order to produce the variables monitored by the decision module. Since we assume that oil revenues are important to the producing-country decision-makers, we also include the country-company contractual arrangements in our module. These are currently in a state of flux, and so as a specific example for this working paper we show the contractual arrangements which would have been in effect for Saudi Arabia had the 1971 Teheran agreement, the 1972 and 1973 Geneva agreements, and the 1972 participation agreement not been superceded.[3]

Under those arrangements, our module would first determine the current month's posted price (PP) in dollars per barrel in accordance with the provisions of the above

mentioned agreements. The terms of those agreements provided for monitoring an index based upon a group of currencies and adjusting the posted price (to compensate for inflation) whenever the index changed value by more than 1% from its value for the previous month; the value of the index would be specified by the user for the time period to be simulated.

After the value for posted price (PP) has been determined, the tax revenues (TR) to be paid to the producing country would be computed using the current TAXRATE, ROYALTY, cost of production (COP), and the government's current participation SHARE. Similarly, the revenue accruing to the producing country government as a result of sales of its independently owned crude oil is computed. The crude revenue (CR) is determined from consideration of the amount of crude oil sold independently by the government (INDCRUD), the price received by the government in such transactions (INDSALE), the cost of production (COP), and the price (SELBAC) paid to the governments by the companies for country-owned crude "bought back" by the companies. After completion of computation for crude revenue and tax revenue, control passes back to the decision module.

The producing government decision-makers are considered here to evaluate the performance of the oil sector at the end of every month, and then to make whatever adjustments they consider appropriate for the next month's operations. These adjustments (if any) are embodied in the values of

various parameters (i.e., DPIR, PAPC) which are provided when the oil module is activated each time by the decision module.

However, although the logical organization of the oil module is very simple, a few of the individual operations within it, which are claimed to be reasonably suitable representations (for our purposes) of crude oil operations, should probably be discussed in more detail. In particular, the existence of several assumptions should be made explicit, and arguments for their use should be presented. As mentioned earlier, the assumptions made reflect (hopefully) the unique character of crude oil operations in the countries of interest, and should be interpreted only within this limited context.

There are two parts of the module which should be discussed. The first is that dealing with capital investment and increases in production capacity. In the present version of our module, governmental decision-makers in the producing countries are assumed to formulate a desired production level to be reached at a given target date. If the currently available production capacity is insufficient to permit production at the desired level, it is assumed that the decision-makers will build (or permit to be built) the necessary additional capacity. The decision-makers will produce a scheme which specifies the additional capacity per month (DPIR) which is to be added over some chosen number of months ending with the target date. If the

currently available production capacity is more than sufficient to permit production at the desired level, then the decision-makers will decide to produce at less than 100% of capacity. In this latter case, the parameter PAPC will be set to the appropriate value (less than 1.0) whenever the reduced production level is to go into effect, and then will be adjusted in succeeding months to further decrease, to increase, or to maintain the same level of production.

The major assumption taken when the module was formulated was that (within reasonable limits) there is no opposition by the major oil companies to increasing production capacity, and that in fact they will always push to increase production (and thus production capacity) to the maximum level permitted by the producing-country government.[4] This further assumes that nothing restricts the companies or countries' ability to afford whatever level of capital investment is necessary for such capacity increases. In Saudi Arabia, at least, these two assumptions seem reasonable. Aramco, the major oil producing company in Saudi Arabia, has undertaken a major expansion program aimed at increasing production there from 9 million bbl/da at the end of 1973 to 20 million bbl/da at the end of 1980, and the program was undertaken even though Saudi opposition to production rates greater than 7-8 million bbl/da was publicly known.[5] Furthermore, during the embargo the Saudi government showed itself quite capable of reducing production to less than 100% of capacity, at least in the short run.

Finally, we assume that producing country decision-makers are aware of the value of ADBR, the average delay between the time capital is committed for an increase in capacity and the time such new capacity is fully installed and operational. Given that all of the countries of interest here have experienced sizeable increases in production levels during the last decade or so, it seems reasonable that they would have reasonably accurate data on how long it takes to construct and connect various kinds of new facilities (including wells). An implicit assumption here, however, is that relatively little uncertainty attends decisions concerning how production capacity can be increased (where to drill, and so on). In the countries under study, and especially in the Persian Gulf, this is a very reasonable assumption. Known reserves and pools are capable of supporting relatively large increases in production with the application of straightforward development processes.

The second part of the module which should be discussed is that concerning increases to proved reserves. Proved reserves are the amount of oil ultimately recoverable with presently installed equipment and under current economic conditions. They may represent either a relatively large percentage or a relatively small percentage of the oil-in-place in a given pool or field, depending upon conditions within the pool or field and upon how extensively developed the pool or field may be. But it is important not to confuse proved reserves with

oil-in-place, since the former are influenced by both economic and operational considerations, while the latter is not. Adelman points out that "The more development wells are drilled into a pool, the more is known about the character of the pool and the better become the estimates of what will probably be produced from it."[6] Furthermore, "The oil company can thus keep on adding to its proved reserves for many a year without ever finding a new field or even a new pool, and with zero or modest additions to oil-in-place."[7]

The oil module takes account of increases to proved reserves which result from development drilling, but makes no attempt to account for any increases which might result from discovery of major new fields. There are two major reasons for this. First, even if a major new pool or new field were to be found, its initial impact would probably be much greater upon estimates of oil-in-place than upon estimates of proved reserves. One cannot say a great deal about ultimate recoverability (with reasonable confidence) until one attempts to define the limits of the pool or field and has performance data from wells drilled for that purpose. But in the Middle East, at least, any pool or field which would add significantly to proved reserves would, because of geological conditions in that area, also be likely to produce huge amounts from these developmental wells. Hence an addition to proved reserves

would once again tend to be associated more closely with a notable increase in production than with the initial "wildcat" well.

The second reason for ignoring the wildcatting type of exploration has been stated very clearly by H.R. Warman: "It is my firm belief that the heyday of discoveries in the Middle East is past and although many large fields (by world standards) remain to be found there the bulk of the oil and the largest fields have been found."[8] And, from Adelman again, "Let us refrain from guessing what this continued [Eastern Hemisphere exploration] activity means for finding new fields. The effect of chance is too great."[9] It thus seems reasonable to permit the user to exogenously raise the level of proved reserves to simulate the chance discovery of a major new field, but it seems equally reasonable not to attempt to treat wildcat exploration within the module.

The next step in development of the oil module is to conduct a series of trial runs using data from various countries of interest. This will be done as soon as the overhead programming general to all the modules is completed. At that time, the performance of the module in its present form may be more fully appraised, and any necessary modifications made and tested. In addition, more detailed documentation will be produced on the various parameter values calculated and parameter estimation

methods used. In the meantime, this working paper should serve as an introduction to the structure and logic of the basic module, and as an indication of the direction of the module's development.

Footnotes for Section II

[1]The case of revision is built into the overhead programming for the simulation, and thus is not seen in the source code for the oil module shown in Figure II-2.

[2]This delay mechanism is a very simple one. The desired production capacity increase is stored for a given number of months, where the number of months is meant to be an approximation of the time required for the needed facilities to be built and to become operational. After the given number of months has passed, the capacity increase is brought "on line" and considered fully operational.

[3]For details of the Teheran and Geneva agreements, see respectively:
OPEC Annual Review and Record, 1971, pp. 7-8.
Petroleum Press Service, July, 1973, pp. 263-64.
For details of the Saudi participation agreement, see "Boom Times in the Gulf," Washington Post, July 22,1973, pp. C2-C3.

[4]This is for the case where capital investment for capacity increases is the responsibility of the contracting oil companies. If the responsibility for capital investment lies with a producing country's national oil company, there would seem to be no problem, subject of course to the national oil company's ability to raise the necessary capital.

[5]"Boom Times in the Gulf," Washington Post, July 22,1973, pp. C2-C3. See also the New York Times, August 9, 1973, for details of the Aramco investment program.

[6]M.A. Adelman, The World Petroleum Market, Baltimore: Johns Hopkins University Press, 1972, p. 28.

[7]M.A. Adelman, 1972, p. 30.

[8]H.R. Warman, "The Future Availability of Oil," paper presented at the Financial Times/BOAC Conference on World Energy Supplies, 18-20 September, 1973, Grosvenor House, London, p. 8.

[9]M.A. Adelman, 1972, p. 205.